Gallbladder Injuries Resulting from Blunt Abdominal Trauma

An Experience and Review

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Over a seven-year period from 1973 through 1979, 31 patients with blunt gallbladder trauma were treated at the Maryland Institute for Emergency Medical Services Systems. Twenty patients had contusions, ten patients had avulsions and one patient had a perforation of the gallbladder. None of the gallbladder injuries were suspected preoperatively. Twenty-eight of the 31 patients had a diagnostic peritoneal lavage performed on admission, all were positive for blood; bile was not grossly evident. Among the 30 patients, there were 75 associated intra-abdominal injuries; there were 25 liver injuries. Five patients died, none as a result of their gallbladder injury. Cholecystectomy is suggested as the definitive procedure of choice for severe contusions and for perforating and avulsive injuries to the gallbladder. Cholecystostomy is indicated in a few patients and should be regarded as a temporary procedure. A review of the English literature shows a total of 101 patients (including the 31 of this study) with gallbladder injuries secondary to blunt trauma. The most commonly reported injury was perforation. The 20 contusions described in the present study are the first such injuries reported.

THE GALLBLADDER IS afforded significant anatomic protection from external blunt trauma. Partially embedded in the relatively massive liver substance, cushioned by the surrounding omentum and intestines, and shielded by the bony cartilaginous rib cage, the gallbladder is rarely injured. However, this protection does not afford complete immunity to blunt trauma injuries, particularly from a localized forceful blow or from rapid shearing acceleration–deceleration forces. In contrast to earlier reports, in which falls, kicks, or blows were the most common factors causing blunt gallbladder injuries, motor vehicular crashes are now one of the primary causes of such injuries. We present a review of our experience with 31 gallbladder injuries secondary to blunt abdominal trauma.

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Submitted for publication: May 27, 1980.

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Patients and Materials

Thirty-one patients with gallbladder injuries were identified in a group of 1449 patients (2.1%) who sustained blunt intra-abdominal injuries and underwent exploratory laparotomy, during a seven-year period from January 1973 through December 1979 at the Maryland Institute for Emergency Medical Services Systems. Records, including operative and pathology reports, were reviewed to study the mode and extent of gallbladder injury, associated injuries, treatment, and morbidity and mortality rates. In all patients, the diagnosis of gallbladder injury was first made during laparotomy. No unrecognized gallbladder injuries were noticed in patients who had postmortem examinations during this period.

Results

The patients ranged in age from 16 to 54 years; 25 of the 31 patients were male. Motor vehicular crashes were the causes of injury in 30 patients (two patients were pedestrians struck by cars), the other patient sustained a crushing industrial injury. In 28 patients, open diagnostic peritoneal lavages were performed, and all were positive for blood. No bile was seen in any of the lavage returns. Based on our criteria, a moderately or strongly stained bloody lavage is considered an indication for laparotomy.[18] All these patients underwent exploratory laparotomy. In three patients, obvious signs of intra-abdominal injury negated performing lavage.

0003-4932/81/0100/0060 $00.85

TABLE 1. *Blunt Gallbladder Injuries at MIEMSS (1973–79)*

	Number of Patients	Per Cent
Contusion	20	65
Avulsion	10	32
Laceration	1	3
	31	100

Types of Injury and Treatment (Tables 1 and 2)

Twenty patients had contusions of the gallbladder. Ten patients with extensive gallbladder contusions underwent cholecystectomy. Eight minimal contusions were treated expectantly. One patient with a moderate to severe contusion of the gallbladder was treated expectantly. This patient's subsequent oral cholecystogram two weeks after surgical exploration demonstrated a normal gallbladder. In another patient, a cholecystostomy was performed for a contused gallbladder, because obscured anatomy in the region of the hepatoduodenal ligament prevented the performance of a cholecystectomy. Ten patients with avulsive injuries were treated, all injuries involved partial avulsion of the gallbladder from its hepatic bed. Nine of these patients with avulsive injuries were treated with cholecystectomy. In one patient, a minimal avulsive injury was treated expectantly. An oral cholecystogram performed one month after injury, in this patient, was normal. The only laceration of the gallbladder was in a patient who sustained an injury to the right lobe of the liver, and a laceration of the inferior vena cava. Cholecystectomy was performed in this patient. Drainage of the subhepatic space complemented every cholecystectomy and the cholecystostomy.

Associated Injuries

In only one of the 31 patients in this study, was the gallbladder found to be the only intra-abdominal injury (3.2%). In the other 30 patients, 75 intra-abdominal injuries were found or 2.5 per patient (Table 3). Twenty five of the 30 patients (83%) had lacerations of the liver. Splenic lacerations (11 patients), mesenteric injuries (ten patients), and intestinal injuries (nine patients) were the next most commonly seen injuries.

Morbidity and Mortality Rates

No complications directly related to gallbladder injury were seen, including no "delayed ruptures" of the gallbladder. Five patients died; two from head injuries, one from acute respiratory failure, one from acute renal failure, and one from severe hemorrhage from other organ injuries.

TABLE 2. *Treatment of Blunt Gallbladder Injuries at MIEMSS (1973–79)*

	Cholecystectomy	Cholecystostomy	Expectant Observation	Number of Patients
Contusion	9	1	10	20
Avulsion	9	—	1	10
Laceration	1	—	—	1
				31

Discussion

Because of its size and peculiar anatomic position, the gallbladder is infrequently injured. The incidence and total number of gallbladder injuries secondary to blunt trauma is difficult to ascertain from review of the English literature. The difficulties occasioned by sporadic reports of one or a few patients in diverse publications, the overlapping of patient reports, and difficulties encountered by reporters in interpreting gallbladder injuries (*i.e.*, were "delayed ruptures" simply unrecognized gallbladder perforations) make it difficult to estimate the incidence and absolute number of gallbladder injuries. Several generalizations can be made. In a review of 5070 patients who sustained blunt and penetrating abdominal trauma, Penn,[49] in 1962, reported a 1.9% incidence of gallbladder injuries. In a personal review of 97 patients with both blunt and penetrating trauma, Penn reported a rather high incidence (5.2%) of gallbladder injuries. In fact, in two of 16 patients (12.5%) with blunt trauma, gallbladder injuries were encountered. In 1905, Ricketts[52] presented a review of 273 patients with traumatic (both penetrating and blunt) and spontaneous ruptures of the gallbladder. Forty-eight patients had traumatic rupture, of which only five can be clearly identified as resulting from blunt trauma (two falls and three blows to the abdomen). A report by Hall and colleagues,[32] of 25

TABLE 3. *Associated Intra-abdominal Injuries in 30 Patients*

Injury	Number of Injuries
Liver laceration	25
Splenic laceration	11
Mesenteric tear or hematoma	10
Serosal tear or hematoma of intestines	9
Pancreatic contusion or hematoma	6
Peritoneal hematoma	6
Diaphragmatic laceration	3
Kidney laceration	1
Vascular injury	
inferior vena cava	2
portal vein	1
hepatic artery	1
	75

TABLE 4. *A Review of Blunt Gallbladder Trauma*

Study	Number of Patients	Type of Injury				
		Perforation	Partial	Complete	Contusion	Other
Ricketts[52]	5	5	—	—	—	—
Norgore[47]	18	18	—	—	—	—
Present series	31	1	10	—	20	—
3 cases or less 2–6,8–10,12,14–16,19,21,23,24,27,28, 31–33,36,39,41,43–46,48,49,54, 56,59–62,64,65	47	36	3	6	—	2*,†
	101	60	13	6	20	2

* Traumatic cholecystocutaneous fistula.[30]

† Bile ascites 2° to a mucosal laceration.[58]

patients sustaining gallbladder injuries revealed that two injuries (8%) resulted from blunt trauma. In reviewing other reports, Hall et al. noticed that 2–3% of the patients who sustained abdominal injuries incur gallbladder injuries. Their literature review contains references mostly from military conflicts involving penetrating injuries. In a 1946 review, Norgore[47] noticed 32 patients who sustained traumatic rupture of the gallbladder secondary to blunt abdominal trauma. Considering ten of these patients were previously presented by Ricketts as having "traumatic rupture" of the gallbladder (cause not stated), two were due to blunt trauma and previously reported by Ricketts, and two were actually due to penetrating trauma, as confirmed by other reports, one is left with 18 newly reported patients who sustained blunt gallbladder trauma. In a 1963 review, Barnes and Diamonon[4] noticed 48 patients with solitary rupture of the gallbladder without other intra-abdominal injuries secondary to blunt trauma. In 1969, Schechter[54] noticed that a "cursory review" of the world literature revealed about 100 patients with "solitary wounding" of the gallbladder secondary to blunt trauma. The type of gallbladder injury was not stated. Given the problems previously stated in estimating numbers of gallbladder injuries, our review of the English literature through December 1979 reveals 101 patients with gallbladder injuries resulting from blunt abdominal trauma, including the 31% in this study (Table 4). Prior to this report, gallbladder perforations in 59 of 70 patients were reported (84%), and avulsive injuries in nine patients (13%) sustaining blunt gallbladder trauma were reported. The gallbladder contusions presented here, are the first reported in the English literature. Our experience in treating 31 gallbladder injuries represents the largest single institutional experience of gallbladder trauma reported in the English literature. One should note that a collective review of 39 patients with blunt trauma rupture of the gallbladder is presented in the Russian literature by Rarenko.[51]

Classification of Gallbladder Injuries

Several types of gallbladder injuries may result from blunt trauma. Smith and Hastings[60] classified injuries of the gallbladder as being those of contusion, avulsion, or laceration.

Laceration of the gallbladder, also termed "traumatic rupture" or "perforation," is the most commonly reported type of gallbladder injury secondary to blunt trauma. In this report of 31 gallbladder injuries secondary to blunt trauma, only one perforation was noticed (3.2%).

Avulsive injuries of the gallbladder are the second most commonly reported type. The gallbladder may be partially or completely torn from its liver bed, while yet remaining attached to the biliary tree, or it may be entirely separated from the liver and its attachments to the common bile duct, lying free in the abdomen. Brown[11] termed this last condition a "traumatic cholecystectomy."

Contusion of the gallbladder probably occurs more commonly than has been reported.[44] Schechter[54] reported that, "Discrete bruising is more often concealed than revealed." Unless other injuries lead to laparotomy, this injury may go undiagnosed, due to a lack of acute signs or symptoms. The large number of gallbladder contusions identified in this report probably is the result of the liberal use of peritoneal lavage in evaluating all patients sustaining or suspected of sustaining blunt intra-abdominal injury. The natural course of an untreated contused gallbladder is not known. Hicks[34] and Schechter[54] speculated that an intramural hematoma may interfere with the blood supplied to the gallbladder wall, resulting in necrosis and subsequent perforation.

Rare patients with "delayed rupture" of the gallbladder have been reported by Coulter[14] (2 days before rupture), Brickley and colleagues[9] (2 patients, eight days and three weeks before rupture), and Fielding and Strachan 24 (10 days before rupture). It is

conceivable that unrecognized contusions of the gallbladder can lead to such a delayed rupture. It is also possible that patients with delayed rupture of the gallbladder simply represent small unrecognized gallbladder ruptures that have been sealed off by the surrounding omentum and intestines. The recognition of a ruptured gallbladder follows when bilious collections increase in size and/or infection and/or jaundice occurs.

In addition to perforating, avulsive, and contusive injuries of the gallbladder secondary to blunt trauma, Penn[49] added "traumatic cholecystitis" as a pathologic entity secondary to gallbladder trauma. In addition to Siegel's patient, Hicks[34] reported patient reports of Ireneus,[38] Epstein and Lipschutz[22] and Hoffman.[35] A common underlying factor in these four patients seems to be blood in the gallbladder, resulting from an occult gallbladder injury or from a liver injury (hemobilia), which blocks the cystic duct precipitating acute cholecystitis, which in Siegel's patient resulted in gangrene and perforation. In Sanblom's[53] classic report on "traumatic hemobilia," three patients with obstructed gallbladder disease secondary to probable hepatic bleeding into the biliary tree, and subsequently into the gallbladder, (including Siegel's report) are presented. One may view cholecystitis resulting from hemobilia from a liver injury as a secondary form of injury to the gallbladder from blunt abdominal trauma. In the traumatized patient, acute cholecystitis may result even though the gallbladder is not injured. DuPriest and colleagues[17] reported 11 patients with acute acalculous cholecystitis complicating trauma. No patient had a discernable injury of the gallbladder at initial exploration, while six patients had significant liver injuries. The report emphasizes that cholecystitis may occur after trauma and surgery unrelated to the gallbladder. Occult trauma to the gallbladder, including intracystic hemorrhage or damage to the blood supply of the gallbladder, could not be ruled out. One may speculate that some patients with "delayed rupture" of the gallbladder have an advanced form of post-traumatic acalculous cholecystitis, secondary to blunt abdominal trauma.

Solhiem[58] added a fifth unusual classification of blunt gallbladder trauma: biliary peritonitis without perforation. He reported a patient in which a mucosal tear of the gallbladder was thought to have allowed bile to seep through the remainder of the intact gallbladder wall. It has been postulated that an intact mucosa is necessary for the retention of bile within the gallbladder. Hence, injury or disease of this layer could lead to leakage of biliary contents into the abdominal cavity.

Grimes and Steinback[30] noticed an additional lesion in an elderly patient with cholelithiasis. Their patient developed a cholecystocutaneous fistula as a result of a calculous becoming embedded in the abdominal wall from a blunt traumatic rupture of the gallbladder.

Mechanisms of Gallbladder Injury

Commonly reported causes of blunt trauma resulting in gallbladder injury include: motor vehicular crashes, falls from heights, and direct blows to the abdomen. All of our patients were victims of motor vehicular trauma except one, who was involved in a crushing industrial accident. As in other intra-abdominal organ injuries, the responsible factors include a direct blow or a shearing acceleration–deceleration force.

Direct blows to the abdomen probably play the major role in rupture of a normal gallbladder. Smith and Soderberg[61] noticed three factors predisposing the gallbladder to rupture, secondary to blunt trauma. First, it appears that the thin-walled normal gallbladder is more prone to rupture due to blunt trauma than a diseased gallbladder. This paradoxical idea, previously emphasized by Brickley and colleagues,[9] and later supported by Schechter,[54] contradicts the opinion of Davis and German.[15] The fibrotic, thickened wall of the chronically inflamed gallbladder probably makes it less prone to rupture. The second predisposing factor in rupture of the gallbladder is the degree of filling at the time of trauma. Hollow viscera are prone to rupture when distended and traumatized. Rapid increases in external pressure result in increased intraluminal hydraulic pressures, causing the bursting of hollow organ walls. Schechter,[54] Knepper and colleagues[41] and Norgore[47] noticed that the postprandially distended gallbladder is more prone to rupture. The third factor contributing to gallbladder rupture is alcohol ingestion. It is known that alcohol causes an increased sphincter tone at the choledochoduodenal junction.[50] This condition would allow for gallbladder distention, and would also decrease the ability of the bile ducts to vent increased pressure applied to the gallbladder. Although not studied in our patients in this report, another report from this institute showed that almost one-half of our patients involved in motor vehicular crashes consumed alcohol, of which, four-fifths did so to an intoxicating degree.[57]

Shearing forces are probably the major factor contributing to an avulsive injury of the gallbladder. Considering the difference in mass between the gallbladder and liver, it would seem reasonable to postulate that exposure to acceleration and deceleration forces could result in shearing forces between these two organs. Depending on the shearing forces applied (considering magnitude, direction and length of time

of application) and normal variations in gallbladder fixation to the liver, shearing forces can result in partial or complete separation of the gallbladder from its hepatic bed. One may postulate that the distended gallbladder is not only prone to disruption but is also more prone to avulsion because of its greater mass when filled with bile.

Diagnosis in Blunt Gallbladder Trauma

The diagnosis of blunt gallbladder injuries (including ruptures) have rarely been made preoperatively. In most reports, the diagnosis was first made either at initial laparotomy, performed for suspected intra-abdominal injury, or at a later date, when the patient presented with an acute surgical abdomen. In other reports, the diagnosis was made at autopsy. Fletcher[26] graphically described the development of progressive deterioration from generalized bile peritonitis. He noticed that fluid extravasation into the abdominal cavity leading to transient hypovolemic shock may occur in response to bile within the peritoneal cavity. In blunt trauma, where the bile is most likely to be sterile, the resulting peritonitis is usually chemical. Unless bacterial peritonitis supervenes, generalized biliary peritonitis after trauma may be innocuous. In fact, it is not unusual to have the patient discharged from the hospital, only to return days or weeks later with a few or numerous signs and symptoms of peritonitis, including weight loss, nausea, vomiting, abdominal distention, jaundice, acholic stools, ascites, low grade fever, and abdominal pain. Norgore[47] notes several earlier reports of Czerny, Cholow, and Fifeld, who reported patients from whom large amounts of bile stained fluid were drained from the abdomen five weeks, 43 days, and two months following injury, respectively. All these patients had sustained blunt trauma ruptures of the gallbladder. Mentzer's[45] report illustrates the benign nature of sterile bile peritonitis.

There are few pathopneumonic signs and symptoms or auxillary diagnostic tests that aid in the diagnosis of gallbladder injuries. Penn,[49] and Fielding and Strachan[24] indicate that jaundice may be helpful in making the diagnosis of gallbladder rupture. Roentgenographic studies are of little value in diagnosing gallbladder injury. Whether or not the gallbladder is able to concentrate contrast material following trauma is not known.[37] As noticed previously, two of our patients, one sustaining a moderate contusion and the other a minimal avulsion of the gallbladder, had normal oral cholecystograms several weeks after injury. Concerning gallbladder rupture, Hogue and Munnell[36] and Solheim[58] noticed that routine roentgenograms may demonstrate signs of intra-abdominal fluid and peritoneal irritation. Fielding and Strachan[24] noticed that roentgenographic evidence of a right hypochondrial mass indenting the colon may be a tipoff to gallbladder perforation.

Intra-abdominal hemorrhage from a traumatic rupture of the gallbladder has not been reported as a primary event leading to an exploratory laparotomy. However, hemoperitoneum secondary to rupture of diseased gallbladders have been reported by Fitts and colleagues[25] and Cohen and colleagues.[13]

The aspiration of abdominal fluid may aid in the diagnosis of blunt gallbladder trauma. Reports by Brickley and colleagues,[9] Hogue and Monnell,[36] Barnes and Diamonon,[4] and Jackson[39] reveal that abdominal paracentesis, with the aspiration of bilious contents, led to the surgical exploration of patients found to have gallbladder ruptures secondary to blunt trauma. However, negative taps have also been reported by Smith and Soderberg[61] and Ali[2] in cases of gallbladder rupture. Davis and German[15] noticed that abdominal paracentesis is not a "logical preoperative procedure" because of the possibility of false negative aspiration. Recent reports reveal that, as opposed to paracentesis, peritoneal lavage is a much more sensitive indicator of intra-abdominal injury. Several series[1,18,20] attest to the sensitivity of this test in detecting intra-abdominal injury. In our series of 31 patients, 28 had a peritoneal lavage performed preoperatively. All lavages were positive for blood; none were bile stained. As noticed previously, a number of patients in our study sustained only minimal gallbladder contusions which required no surgical therapy. However, 75 associated intra-abdominal injuries were noticed in 30 patients. This incidence of 2.5 injuries per patient reflects the severity of intra-abdominal injuries seen in our multiply injured patients. The frequently seen liver injuries in the majority of our cases were significant, and required at least evacuation and drainage of blood. The associated injuries usually were the cause of a positive lavage and led to exploratory laparotomy. Frank and colleagues[27] relate an unusual method of making the diagnosis of traumatic rupture of the gallbladder. These reporters used a "skinny" needle percutaneous transhepatic cholangiogram to make the diagnosis on their patient's forty-fifth hospital day. (Note, an earlier paracentesis revealed a fluid with a hemoglobin of 13 mg/dl.)

Treatment

A variety of treatment options are available in the management of gallbladder injuries, including: expectant observation, drainage, cholecystorrhaphy, or extirpation of the gallbladder.

Ricketts[52] noted in 1905 that when operative maneuvers were employed in the treatment of traumatic rupture of the gallbladder, ". . . brilliant results (were) obtained." These earlier maneuvers frequently consisted of surgical drainage or paracentesis of intraperitoneal collections of bile. Although the gallbladder was not visualized in many of these earlier reports, it was assumed that the drained bile came from ruptured gallbladders due to "traumatism."

In 1887, Dixon[47] performed the first cholecystectomy for rupture of the gallbladder. The 32-year-old man who was injured in a fall, died on the seventeenth postoperative day from "cholemia" resulting from concretions in the common bile duct. In 1898, the first successful surgical maneuvers for rupture of the gallbladder were reported. Thomas[47] removed the avulsed gallbladder of a 14-year-old boy injured in a fall and Bullinger[47] repaired a rent in the ruptured gallbladder of a 23-year-old woman. The patients survived.

Once it was appreciated that surgical intervention for rupture of the gallbladder is necessary for survival, few deaths have followed. In the succeeding 50–60 years, tears in the gallbladder that were deemed repairable were sutured. Smith and Hastings[62] echoed the thoughts of previous surgeons in recommending the closure of simple lacerations of the gallbladder to preserve the organ for "further usefulness." Thal and colleagues[32] supported the view that only extensively damaged gallbladders should be removed. They recommended cholecystostomy for patients in poor condition or in an attempt to preserve a contused but viable organ.

Knepper and colleagues[41] stated that the ruptured gallbladder should be removed. Manlove and colleagues[44] agreed that "in general" traumatic ruptures of the gallbladder were best treated with cholecystectomy. Hogue and Munnell[36] concurred with Manlove et al., stating that "cholecystectomy is ideal." They feared that the injured and repaired gallbladder would become a nidus for future calculous formation. Cholecystostomy was viewed only as a temporizing procedure.

Reports from the last two decades indicate that cholecystectomy is viewed as the operation of choice for traumatic ruptures of the gallbladder. In gallbladder ruptures in children, several authors including Songsanand and Groff,[59] Evans,[21] and Benson and Prust[5] feel that preservation of the injured organ should be attempted. Their efforts include simple suturing,[21] cholecystostomy[59] or both.[5]

Cholecystostomy should be viewed as a procedure of second choice, *i.e.*, as opposed to cholecystectomy in the treatment of the injured gallbladder. Its use is advocated in a desperately ill patient or in one in which obscured anatomy in the region of the porta hepatis makes cholecystectomy a hazardous procedure. We performed a cholecystostomy for a contusion of the gallbladder for that reason.

T-tube drainage is not necessary, even in the presence of an associated liver injury,[42] unless there is an obvious injury to the common bile duct.

The routine use of drains in uneventful cholecystectomies has been challenged in recent years. Some reports indicate increased morbidity involving infections when drains are routinely employed after simple cholecystectomies.[29,40,63] However, as noted previously, in patients sustaining blunt traumatic gallbladder injury, concomitant intra-abdominal injuries are often present that require surgical drainage.

The management of contusive gallbladder injuries has been rarely addressed. Manlove and colleagues[44] postulated that such injuries probably go unrecognized, and require only supportive care. With the liberal use of peritoneal lavage in our multiply injured patients, 20 gallbladder contusions have been unmasked. To quantify the extent of contusion, other than subjectively, as simple, moderate and severe would be a difficult task. We advocate cholecystectomy, when feasible, in multiply traumatized patients when moderate to severe gallbladder contusions are encountered. In these patients, many of whom had been in shock, sustained a head injury, received multiple blood transfusions, and required ventilatory support, the possibility of developing an unrecognized acalculous gangrenous cholecystitis in the postoperative period is obviated by cholecystectomy.

Summary

Our experience with 31 gallbladder injuries secondary to blunt abdominal trauma is presented. Cholecystectomy is recommended as the definitive procedure of choice for severe contusions, avulsions and perforations of the gallbladder. A review of the English literature is presented.

Acknowledgments

We wish to express our appreciation to Jill Buffo for technical assistance in preparation of the manuscript.

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